Commutative Properties of Addition and Multiplication

For all Real Numbers a & b:

$$a + b = b + a \qquad a \cdot b = b \cdot a$$

Example

$5 + 7 = 7 + 5$ $\qquad$ $2 \cdot 9 = 9 \cdot 2$

Are the values of the expressions the same?

$12 = 12$ Yes $18 = 18$

Can we apply the same logic to Subtraction and Division?

Associative Properties of Addition and Multiplication

For all Real Numbers a, b & c:

$$(a + b) + c = a + (b + c) \qquad (a \cdot b) \cdot c = a \cdot (b \cdot c)$$

Example

$(5 + 7) + 4 = 5 + (7 + 4)$ $\qquad$ $(2 \cdot 9) \cdot 6 = 2 \cdot (9 \cdot 6)$

Are the values of the expressions the same?

$16 = 16$ Yes $108 = 108$

Can we apply the same logic to Subtraction and Division?

Distributive Property

$$a \cdot (b + c) = ab + ac$$

$$a \cdot (b - c) = ab - ac$$

Example

$5 \cdot (3x - 2) = 15x - 10$ $\qquad$ $9 \cdot (2x + 1) = 18x + 9$

$5 \cdot (3x - 2)$ Multiply 5 times 3x minus 5 times 2

or

$5 \cdot (3x - 2)$ Multiply 5 times 3x plus 5 times a negative 2

Identity Property of Addition

For all Real Numbers a:

$$a + 0 = a$$

Zero is the identity element for Addition.

Inverse Property of Addition

$$a + -a = 0$$

"Additive inverse" is another name for "Opposite"